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And Other Good Things

Although harvest celebrations are as old as civilization, the first for our country was probably held during November 1621 in Plymouth, Mass. According to legend, the Pilgrims had a poor harvest that year, but 20 acres of corn planted under the direction of the Indian Squanto had thrived.

The Pilgrims held a 3-day festival. Four men were sent "fowling" and killed enough to supply the town for a week. The Indian Chief Massasoit and some 90 "brightly painted braves" killed five deer and "other good things."

The Pilgrims and their guests "gorged" themselves with venison, duck, goose, clams and other shellfish, cornbread, eels, leeks, watercress and other greens, wild plums, and dried berries. They drank wine made from wild grapes.

Although turkey is not specifically mentioned, most historians assume that turkey, grouse, rabbits, and other small woodland game were the "other good things" Massasoit brought.

Little thought was given to proper nutrition—bare survival was enough. Today, however, modern research has given us the tools to measure the nutrients in our foods.

Assuming that we, too, will overindulge ourselves this Thanksgiving, we will consume 2,047 calories in one meal, according to data taken from ARS' Handbook 456. This includes the barest essentials—generous servings of turkey, white and candied sweet potatoes, gravy, oyster dressing, cranberry sauce, relishes (tomato juice, celery, carrots, and olives), rolls and butter, and pumpkin pie.

How nutritious is all this food? It contains nearly all the calories an adult male needs in one day (too much for a female). Compared to the National Academy of Sciences' daily recommended dietary allowances, this one meal is high in protein, niacin, ascorbic acid, and vitamin A. It's low in calcium and phosphorus. And it's about right in iron, thiamin, and riboflavin. It's also about 40 percent fat, which may be too high for those on low-fat diets.

Only through modern agricultural research and technology can we enjoy the luxury of such a feast. Of all countries, ours is the most successful in the world in its ability to provide such a vast variety and abundance of foods. Like the Pilgrims, we, too, should pause and give humble thanks.—*M. M. M.*

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COVER: In deep percolation studies, Dr. Mielke checks the volume of leachate collected from 5 feet below the surface of a cornfield. Water at that depth is unavailable to corn plants, indicating water use inefficiency (0776X933-19). Article begins on page 8.

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AGRICULTURAL RESEARCH



Alfalfa is exposed to both normal and carbon-filtered air in these open-topped plastic chambers at California's Statewide Air Pollution Research Center at Riverside. Dr. Thompson (left) and staff research associate Gerrit Kats are engaged in this research on the effect of smog on alfalfa (0876X1008-33).

SMOG—RESISTANT ALFALFA

SMOG HARMS ALFALFA. First, it drastically reduces leafiness, growth, stand and, thus, ultimate yield. Second, it alters this forage plant's chemical composition.

Tests conducted near Riverside, Calif., show that during 6 months of growing alfalfa in photochemical air pollution (smog caused mainly by auto and industrial emissions), Eldorado, a smog-tolerant alfalfa variety, yielded only about 66 percent as much alfalfa hay in smoggy air as it did in clean air. Hayden, a smog-susceptible variety, yielded less than 60 percent as much in smoggy air.

Even with the heavy smog, growers should get approximately 10 percent more alfalfa hay from the smog-tolerant Eldorado than from Hayden.

Alfalfa and alfalfa mixtures represent about 60 percent of all hay harvested in the United States. Alfalfa is a major feed for dairy cows and any crop loss increases the cost of producing milk. Beef cattle also consume large quantities of alfalfa.

These smog studies began in 1974 at the University of California's (UC) Statewide Air Pollution Research Center, Riverside, with the support and cooperation of ARS. UC research biochemist C. Ray Thompson grew alfalfa in pots placed inside open-topped plastic chambers, 10 feet in diameter by 8 feet high. The two alfalfa varieties were grown in both normal air and in carbon-filtered air.

The researchers harvested the alfalfa in seven cuttings from June to January.

Below: Mr. Kats records fresh weight of alfalfa grown in chambers and subjected to carbon-filtered air or smog, and of alfalfa grown outdoors in ambient air. After weighing, the samples will be sent to the Western Regional Research Center at Berkeley, Calif., to be analyzed for content of basic nutrients and vitamins (0876X1009-17). Right: Smog-grown alfalfa inspected by Dr. Thompson is shorter than average and has smaller than normal leaves. In contrast, the alfalfa at right was grown in carbon-filtered air and displays lush leaves and is of greater height (0876X1009-7).



The amount of smog directly affected yields. Yields of both alfalfa varieties continued to decline as the oxidant or smog level got progressively higher. However, by the fifth cutting some plants had weakened and even died. Even declining smog levels did not help increase production in subsequent harvests.

At the conclusion of the experiment, smog had killed over one-third of the alfalfa plants grown in smoggy air—even the smog-tolerant Eldorado variety.

Dr. Thompson says, "Cattle feeders and dairymen naturally want alfalfa with plenty of leaves. In general, we found 5 to 10 percent more leaves on alfalfa grown in clean air than on alfalfa grown in smog."

After harvesting, the researchers sent alfalfa samples to ARS chemist Eldon L. Pippen at the Western Regional Research Center (800 Buchanan St., Berkeley, CA 94710) for chemical and biological analysis.

Tests conducted by Mr. Pippen showed that smog altered the chemical composition of both varieties. Hayden was particularly hard hit by smog. Smog reduced the fat content by 18 percent, fiber 28 percent, carbohydrate 14 percent, beta-carotene 50 percent, vitamin C 53 percent, and chlorophyll 30 percent compared to alfalfa grown in clean air.

Mr. Pippen says, "We found that niacin production was greater in the smog-grown alfalfas. Somehow air pollution stimulates niacin production.

The percentages of nitrogen, ash, and elements such as bromine, copper, and potassium may have appeared higher because of the lower concentration of crude fiber and other carbohydrates in the smog-damaged alfalfa. However, the total amount of plant nutrients was much greater for plants grown in clean air than for plants grown in smog."

Rats fed protein from alfalfa grown in smoggy air grew as fast as rats fed protein from alfalfa grown in clean air. Another laboratory test indicated the nitrogen digestibility of both alfalfa varieties, whether grown in clean or smoggy air, to be the same.

This information will help researchers who are trying to develop even more smog-tolerant varieties of alfalfa.—*D.H.S.*

Moderation is the Watchword

A HEALTHY DIET is one that is high in protein. Or is it?

Too much of a good thing could have unhealthy results, recent studies show. In most of these tests, experimental, high-protein diets adversely affected the calcium balance in the body despite consumption of extra calcium.

There are conflicting opinions in the scientific community on how much calcium needs to be provided in the daily diet. The common assumption that retention of calcium is improved by high-protein diets is based on meager data.

ARS-funded studies by the Wisconsin Agricultural Experiment Station, Madison, show that college men who consumed experimental diets high in protein content lost excessive quantities of calcium. This adverse relationship, if continued long enough, could result in osteoporosis—the development of hollow areas in the bones, thus weakening them and increasing the risk of breaks or fractures. Osteoporosis is a widespread problem, affecting more than 14 million people in the United States alone.

In studies directed by nutritionist Hellen M. Linkswiler (Department of Nutritional Sciences, University of Wisconsin, Madison, WI 53706), students consumed 800 milligrams (mg) of calcium and 142 grams (about 5 ounces) of protein daily. The daily recommended dietary allowance (DRDA) is about 56 grams for men and 42 for women. The protein in this diet was consumed in ordinary foods, and came principally from lean beef, supplemented with minor quantities from fruits, vegetables, and grain products. As needed, added protein in the form of casein, lactalbumen, gelatin, and wheat gluten was included to bring the protein content to 142 grams. The 800 mg of calcium consumed is the DRDA for this nutrient.

Except for one participant in these

tests, the 800 mg of calcium was not sufficient to achieve and maintain calcium balance in the body during the 65-day experiment. Extra calcium did not help much. Only 20 percent of the students achieved calcium balance when they consumed 1,400 mg of calcium daily, Dr. Linkswiler reports.

In contrast, a low-protein (47-gram) diet had no adverse effects on calcium balance in the body. The students consumed the same food in this diet as in the high-protein diet minus the supplemental sources of protein. Students on the 47-gram diet maintained their calcium balance when they consumed 500 or the DRDA of 800 mg of calcium.

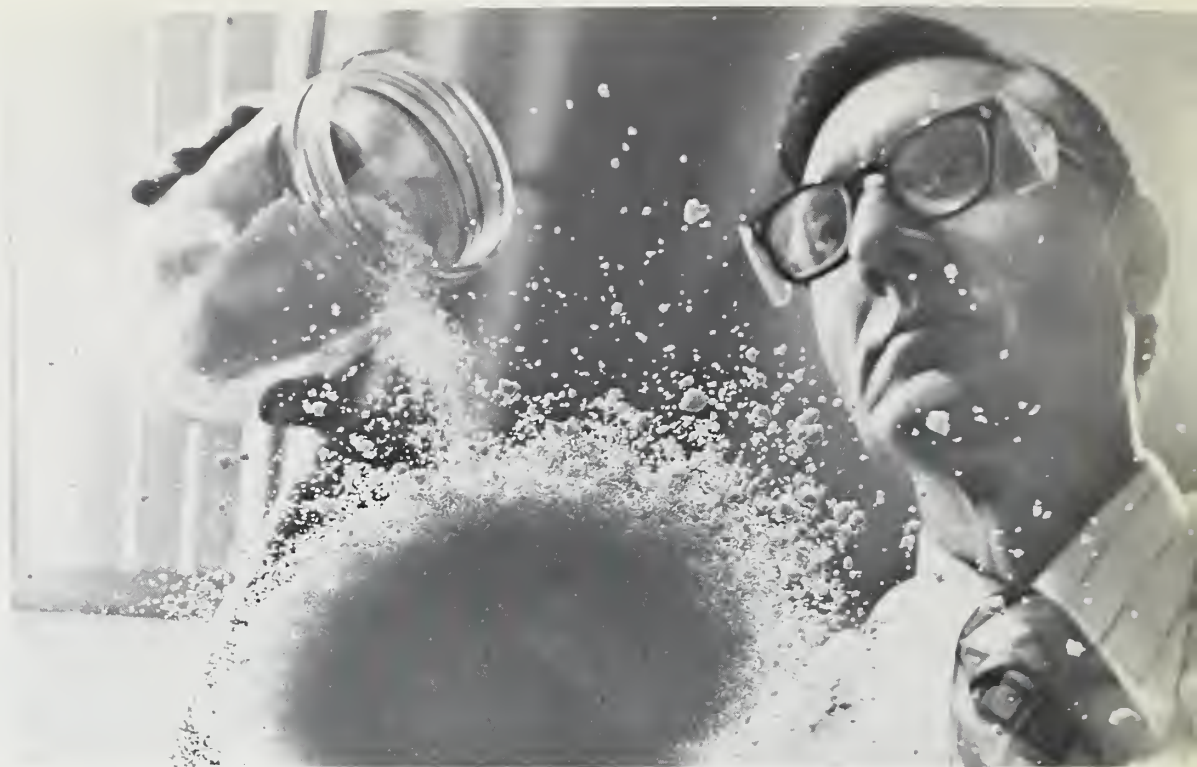
They also maintained their calcium balance in a diet containing an intermediate level (95 g) of protein and 800 mg of calcium daily. However, when their calcium intake was limited to 500 mg daily, the students incurred a net loss of calcium while on this intermediate-protein diet.

The most disturbing loss of calcium, averaging 85 mg daily, occurred with students on the high-protein (142-gram), 800-mg calcium diet. To emphasize the point, scientists cite as an example the expected effects on anyone who stuck to a high-protein diet for long periods, an event that only the most determined “diet freak” might be expected to follow. Such individuals would lose one-third to one-half of the calcium in their bodies, based on 85-mg loss daily for 10 years by a 155-pound man. Earlier work by other researchers has indicated that a smaller loss, 50 mg of calcium daily, could result in significant osteoporosis.

While people are more likely to fluctuate in diets of low or high protein content, the calcium retained during periods of low-protein diets is not likely to be enough to compensate for the losses that occur during consumption of high-protein diets.—D.M.W.

Dr. Doane pours encapsulated pesticide on glass to demonstrate its granular properties (0776X845-29A).

Starchy Protector



INVISIBLE BONDS among atoms of sulfur and carbon in an ARS-developed starch product offer manufacturers of pesticides, rubber, metal products, and paper ways to conserve resources and protect the environment.

Introducing sulfur bonds in soluble starch by xanthating it, then crosslinking the starch xanthate (AGR. RES., May 1963, p. 5) has a waterproofing effect, says chemist William M. Doane of the Northern Regional Research Center (1815 N. University St., Peoria, IL 61604), and makes possible a wider range of uses. For example:

- Wrapping soluble or volatile pesticides in the insoluble starch compound would help keep the chemical action on target and protect the rest of the environment.

- Encapsulating latex with starch xanthate, then crosslinking the starch compound in making rubber, is similar to encapsulating pesticides. The resulting powdered rubber grinds and mixes more easily than conventional rubber slabs and would drastically reduce the industry's use of fuel.

- If insoluble starch is xanthated, the product is an insoluble starch xanthate that behaves like the ion exchange resin in a water softener. It can be used to reduce toxic levels of

valuable metals dissolved in water, recover the metals, and thus reduce water pollution and conserve limited resources (AGR. RES., Mar. 1973, p. 3).

- Since starch xanthate can be made insoluble, it can be used to replace some of the cellulose from pulpwood in making paper. The increasing cost of cellulose reflects the increasing cost and dwindling supply of fuel used in the industry between standing trees and finished paper.

Making paper was the earliest demonstrated application of starch xanthate. Encapsulating pesticides to target the action is the latest.

Chemists Baruch S. Shasha, Charles R. Russell, and Dr. Doane can encapsulate solid or liquid chemicals in starch xanthate for slow release in farmers' fields.

Chemicals that can evaporate, dissolve, or break down in sunlight are trapped in the process by the starch compound and held in insoluble, water-permeable particles that slowly release the active agent. Successive encapsulations of the particles or adding rubber latex to the starch xanthate prolongs the release of the chemical action even more.

To encapsulate a liquid, Dr. Shasha

mixes it with starch xanthate in water and adds an oxidizing agent to crosslink the starch compound when the pH is lowered. To encapsulate a solid, he dissolves it in minimum solvent, then mixes the solution with the starch xanthate in water.

He adds acetic acid, lowering the pH to about 5. This precipitates the starch xanthate as a mass, which contains the pesticide. He filters, washes, and dries the mass and grinds it to granules or powder.

A volatile herbicide, encapsulated in this procedure, showed no appreciable loss at the end of 40 days in storage. Only 7 percent of it evaporated in 5 hours under a heat lamp. Almost 90 percent of the unencapsulated herbicide evaporated in 2 hours under the same conditions.

In the field, the water-permeable particles of starch or starch-latex compound release the active agent near the target weeds, insects, or other pests. Released slowly, the chemical acts longer but in a more restricted area than it would if not controlled.

"Keeping the action where the target is makes the pesticide safer and more effective," Dr. Doane says. "Farmers might make fewer applications of less pesticide. Targeting the

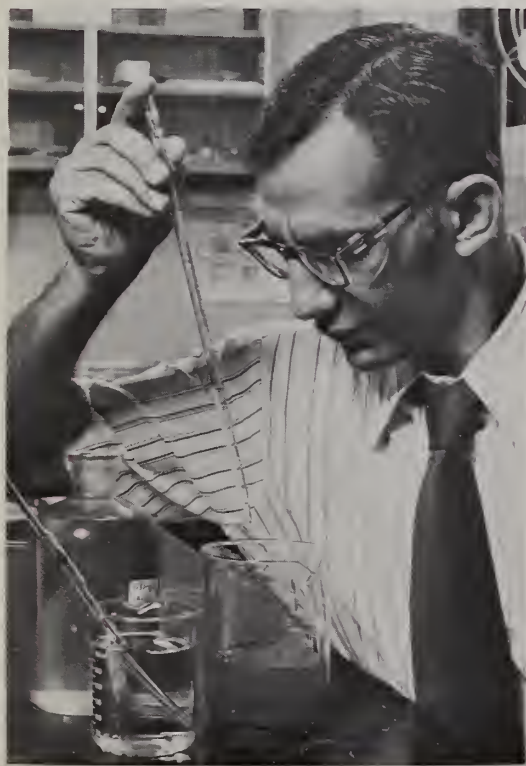
action would reduce danger to handlers and to non-target animals, insects, plants, and the total environment.

"And besides, the starch compound leaves no toxic or unnatural residue in the environment. It biodegrades after it releases the pesticide."

Each of 10 companies is testing its own commercial pesticides encapsulated with starch xanthate or starch xanthate and latex. The companies provided the ARS chemists with a total of 50 commercial herbicide, insecticide, and nematocide samples. Dr. Doane and Dr. Shasha encapsulated each pesticide and returned it for testing to the company that provided it.

Dr. Doane says pesticides manufacturers have been shifting research emphasis from new products to improved ways of releasing established materials on target. One way to solve toxicity and persistence problems is to control the release of the pesticide after it is applied.

"And encapsulation with starch xanthate," he adds, "is one way to control release."—D.H.M.



In laboratory encapsulation tests, Dr. Sasha mixes starch xanthate, sodium nitrate as an oxidizing agent, and liquid pesticide (0776X844-26A).

Gift from the wild

WILD GRAPES may extend a valuable gift to their domesticated fellows—resistance to a devastating disease.

Gums and tyloses (special kinds of cell walls) in the vascular systems of wild grapes could hold the answer to overcoming Pierce's disease in susceptible bunch grapes.

Pierce's disease has twice threatened the vineyards of California. At present, it makes the cultivation of susceptible bunch grapes impossible in the Gulf Coast States. The disease, caused by bacteria and transmitted by insect vectors, cannot be controlled at this time by pesticides and cultural practices; thus, developing resistant varieties of bunch grapes offers what might be the only viable control.

A long step forward in understanding the mechanisms of resistance in grapes has been taken. The striders are ARS microbiologist Hilton H. Mollenhauer of the Veterinary Toxicology and Entomology Research Laboratory (P.O. Drawer GE, College Station, TX 77840) and Donald L. Hopkins, associate professor at the Agricultural Research Center, University of Florida, Leesburg, Fla.

The research team studied three grape types: Thompson Seedless (bunch grape), Scuppernong and Pride (muscadine grape), and *Vitis mansoniana* (wild grape).

The scientists found that the susceptible variety, Thompson Seedless, produced very little gum in the xylem vessels in the presence of bacteria. The tolerant muscadine grape produced more, and the highly

tolerant wild grape much more gum than the muscadine.

Pictures made from a low magnification electron micrograph of slices from leaf veins and petioles of leaves show that the gums and tyloses seal the vessels of the grape plants and encapsulate bacteria in the gum. Thus, the plants seem to trap the bacteria and localize the infection. It is also possible, the scientists think, that the gums may provide a chemical antibacterial defense as well as a mechanical one.

The researchers point out that, in their study of the morphology of the grape plants, they chose samples from muscadine and wild grapes in which tolerance was failing. Most muscadine and wild grapes do not develop symptoms of Pierce's disease. Most tolerant grapevines probably localize the infection immediately and thus have few blocked vessels. When tolerance fails, as in the case of the muscadine and wild grapes selected for the test, a large number of plugged vessels result as the plant struggles to contain the infection.

Since resistance is now the only means of controlling Pierce's disease, the scientists think that finding wild grapevines that produce large quantities of gums and tyloses and crossing them with susceptible bunch grapes could be used to produce additional high quality bunch grape varieties with tolerance to the disease. This could, in turn, provide a new crop for the Gulf Coast States, as well as insurance against the disease in present grape-growing localities.—B.D.C.

This center-pivot irrigation system is typical of those employed in the Platte valley. Center-pivot systems can be used on land that does not meet the requirements of the less adaptable furrow-type system (0776X934-34).



Light Irrigations Conserve

FREQUENT, light irrigations on sandy soil save water and the energy to pump it and also reduce the amount of fertilizer nitrogen moving below the reach of plant roots as a potential ground water pollutant.

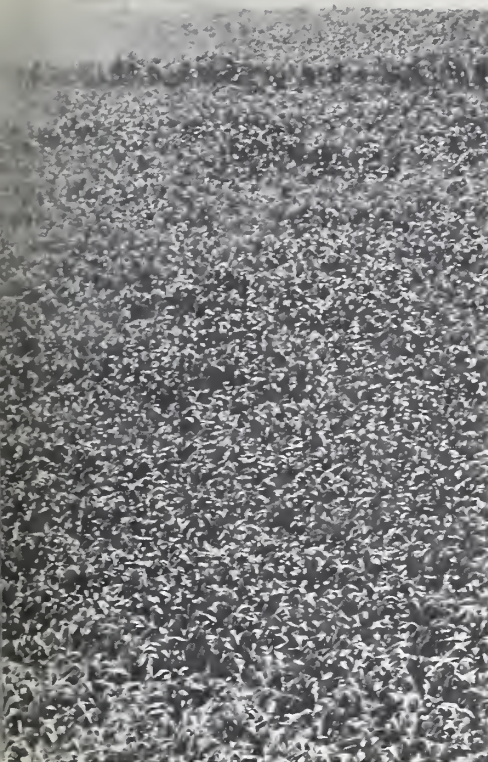
The amount of water and nitrogen fertilizer that can be saved, formerly only estimated, is being measured directly by ARS near Bellwood, Nebr. Preliminary results show a 40-percent reduction in water lost by deep percolation below the rooting zone when average irrigations of the same field were cut from 1.9 inches with surface irrigation to 0.9 inch with sprinkler. Also, 40 percent less nitrate-nitrogen was carried below crop roots.

With furrow irrigation between corn rows 1,130 feet long, 25 percent of the water from irrigation and rainfall was lost as deep percolation during the growing season. This loss was reduced

to 15 percent the next year with smaller applications by a center-pivot sprinkler system. Total nitrate-nitrogen losses averaged 45 and 27 pounds per acre. Half of these annual losses occurred during the first 2 weeks of irrigation when the percolation rate was highest.

Deep percolation under irrigation cannot be entirely eliminated, points out ARS soil scientist Lloyd N. Mielke (137 Keim Hall, University of Nebraska, Lincoln, NE 68583). In fact, rainfall in eastern Nebraska complicates irrigation water management and contributes to deep percolation.

Researchers had no technique for direct measurement of deep percolation until ARS agricultural engineers Harold R. Duke and Howard R. Haise, Fort Collins, Colo., developed the vacuum extractor used in the Nebraska studies. The extractor consists of a porous ceramic tube in a metal tray buried



Left: To determine ground water quality, observation wells are located upstream and downstream from the test cornfield. Collection of samples before and after water passes beneath the test field, as Dr. Mielke is doing here, helps researchers determine the effects of irrigation on ground water quality (0776X934-7). Below: Working at a field vacuum sampler location, Dr. Mielke and Harry Koinzan collect a sample of soil water leachate for lab analysis (0776X932-11).

e Resources

below the root zone. Percolating water is drawn by vacuum pump into the tube and flows by gravity into a container, emptied periodically for volume measurement and nitrate-nitrogen analysis.

In the study, Dr. Mielke and agricultural engineer Charles L. Linderman installed eight extractors and began observations after one growing season intervened. The cooperating farmer followed his usual corn production practices except that irrigation scheduling was based on soil water content measured with a neutron probe and tensiometers.

In the furrow irrigation study, the entire field received 100 pounds of nitrogen per acre as anhydrous ammonia before planting. Part of the field had an additional 80 pounds per acre sidedressed before irrigating, and part received 60 pounds per acre applied in the irrigation water. Rates were slightly



Light Irrigations

lower the next season and no nitrogen was applied with irrigation water.

More nitrate-nitrogen leached below the root zone with sidedress application than when the fertilizer was put on with irrigation water. The loss averaged 6.7 pounds per acre in each inch of percolating water with sidedressing and 5.6 pounds with application in irrigation water.

Sandy soils with shallow water tables are difficult to manage under irrigation. The researchers found that the soil to 5-foot depth would hold only 3 inches of available water. Irrigation was needed every sixth day when the weather was hot, dry, and windy.

The study demonstrated the extreme variability of alluvial sandy soils, Dr. Mielke says. Deep percolation measured by the eight vacuum extractors for the first irrigation season ranged from 0.2 to 14.9 inches of water.

Use of automated gated pipe and shorter furrows as an alternative to the center-pivot system could reduce deep percolation and nitrogen loss, Dr. Mielke says. These alternatives to conventional furrow irrigation require more labor or a higher equipment investment.

The study is continuing, in cooperation with the University of Nebraska, Lincoln, to verify preliminary results with the center-pivot system.—W.W.M.

Above right: Dr. Mielke checks the amount of suction being applied to a field vacuum sampler at this centrally located field monitoring station. The samplers are buried throughout the test plots at a 6-foot depth. Samples taken from them are used to determine water quality and quantity (0776X932-33). Right: Dr. Mielke checks the chart on a rain gage in one of the test fields. The rain gages measure rainfall and the amount of irrigation water applied (0776X933-26).



Another Way to Control Bees

HONEY BEES do not get all shook up when the hive is vibrated, but the ploy does trigger a stopping or "freezing" response leaving the insect vulnerable to control.

This control technique may be a way of overcoming some objections to the use of honey bees to pollinate crops in commercial greenhouses. Among those objections are the danger to personnel and the danger of killing the bees with insecticide application.

Persons fearing bee stings can turn on vibration-producing equipment and, after one-quarter to one-half hour, enter the greenhouse with little risk. Likewise, when insecticides need to be applied, the hive can be vibrated and shortly thereafter can be removed from

the greenhouse and returned when it is safe to do so.

ARS entomologist Hayward G. Spangler (Bee Research Laboratory, 2000 E. Allen Road, Tucson, AZ 85719), says that vibration of the hive—600 cycles—drastically reduces bee activity, including flying from the hive. The reduced flying results in a rapid reduction in the number of bees away from the hive as returning foragers are "frozen" when they reenter.

Dr. Spangler worked with small colonies—about 2,000 bees in a single frame (comb) hive—in polyethylene greenhouses for more than 6 months without obvious harm to the bees. He fed them pollen and sugar syrup to maintain the brood level. Bees made

adequate visits to tomato, onion, and alfalfa blossoms in the greenhouse.

The commercial greenhouse industry in this country grows somewhere around 5 percent of the total crop of vegetables and is expanding rapidly. Most plants in greenhouses are pollinated by some sort of mechanical means. For instance, tomatoes are "shaken" to distribute the pollen via air currents in the greenhouse.

Dr. Spangler induced vibrations in the hive with a sound reproducer driven by an audio amplifier connected to a signal generator. The sound reproducer was installed in the hive frame near the entrance with a wood screw which transmitted vibrations from the reproducer to the frame.—*J.P.D.*

Finding a New Dimension

WHEN a scientist moved into a new dimension recently, he wasn't following Alice through the looking glass, flying through space with Star Trek, or even joining a hard rock band.

He was unraveling the ways and means of poisons.

By showing, for the first time, that a certain chemical reaction occurs in

higher animals by which potentially harmful substances are rendered less toxic in the rumen (the large first compartment of the stomachs of ruminants like cows and sheep), the researcher opened a whole new area in the study of toxicants.

This research, by ARS biochemist Glen W. Ivie (Veterinary Toxicology and Entomology Research Laboratory, P.O. Drawer GE, College Station, TX 77840), opens a new pathway in the exploration of metabolism, detoxification, and excretion of toxicants by mammals.

It may also prove of considerable value in understanding the workings of cancer-causing chemicals.

The newly-shown chemical reaction changes potentially dangerous molecular structures called "epoxides" to less hazardous structures called "olefins." A number of cancer-causing substances have the epoxide structure; thus, a new line of investigation on how these epoxides are changed into olefins could be of value to cancer research.

A few other methods are known by which animals and persons render poisons less toxic. Historically, the knowledge of these methods has been of great value in understanding the mechanisms of poisons and in treating for toxicity. Hopefully, the knowledge of another method of detoxification will be equally beneficial.

The scientist believes that cows and sheep have an enzyme in their digestive system that changes the peculiar structure of the epoxide to that of the olefin. It is very likely that microorganisms in the rumen of the animals cause the conversion of the chemical structures.

Dr. Ivie conducted the study, in part, by tracing chemicals labeled with radioactive materials through the digestive tract of a steer and analyzing the feces and urine. He also made laboratory tests with fluids from the digestive tracts of freshly killed sheep.

In both cases, Dr. Ivie was able to verify the conversion of the dangerous chemical structure into the less toxic one.—*B.D.C.*

Chlamydiosis attacks all the major organs in the body but concentrates its damage on the heart. Heart damage ultimately kills the birds. Dr. Page examines the diseased heart of a challenged, unvaccinated bird. The severely damaged heart is enlarged and encrusted with fibrin (0776X843-0A).

Advancing on Ornithosis



A simple diagnostic test coming into use as well as initial success in developing a protective vaccine are improving the prospects for effective control of ornithosis, a costly disease to turkey growers.

If ornithosis is diagnosed early, prompt treatment with antibiotics can restrict losses. Routine use of effective vaccines may also have a place in control efforts in epidemic areas.

ARS microbiologist Leslie A. Page has improved and evaluated a diagnostic test that is less costly to use than the more cumbersome complement-fixation test. His studies at the National Animal Disease Center (P.O. Box 70, Ames, IA 50010) indicate that an agar gel precipitin test requires less time and labor and can be used by less highly skilled personnel but compares favorably in ability to identify infected flocks.

Five to 40 percent of the turkeys in a flock have died during sporadic outbreaks of the virulent form of ornithosis,

which usually occurs only in coastal areas. The virulent form can also produce serious illness and occasional death in humans who handle sick turkeys.

Ornithosis is an infectious disease of birds caused by the virus-like organism *Chlamydia psittaci*. In parrots and parakeets, it has been known as psittacosis, or "parrot fever." The term chlamydiosis describes the disease produced by *C. psittaci* in both birds and mammals. The range of susceptible species dictates that surveillance to detect outbreaks in turkeys must include domestic poultry, wild birds, and mammals associated with poultry.

Dr. Page says the agar gel precipitin test is particularly adapted for use in surveillance. It detects antibodies to the chlamydial group antigen equally well in serum samples of turkey, pigeon, cow, sheep, horse, and human origin. The antigen used in the test likewise may come from the *C. psittaci* strain associated with any of these species.

The test has been evaluated on thousands of samples by about 20 laboratories and USDA's Animal and Plant Health Inspection Service. It was used experimentally in the past 3 years during outbreaks of virulent ornithosis in South Carolina, Texas, and Georgia.

These outbreaks reemphasized the need of a safe vaccine for use in coastal areas. Earlier attempts to induce immunity in turkeys by inoculation were not promising. Experimental vaccines that gave some protection also left some birds as carriers of the disease and potential sources of reinfection of the flock.

Dr. Page has not only stimulated high levels of immunity in turkeys with an experimental vaccine but has also obtained insight into the type of immunity to *C. psittaci* that is functional in turkeys.

He added a commercial vaccine as an adjuvant to a low-potency chlamydial bacterin that by itself failed to protect turkeys against the virulent strain of



Dr. Page conducts post-mortem examination of unvaccinated turkeys whose immunity was challenged by introducing live, virulent Chlamydia psittaci. The healthy birds were vaccinated. Masks and gloves are worn to protect the researchers against infection (0776X843-6).

the organism. This combination, administered intratracheally, stimulated immunity in 85 percent of the inoculated turkeys when they were exposed to birds infected with the virulent strain isolated during the 1973 outbreak in South Carolina turkeys.

The adjuvant is a concentrated suspension of inactivated *Bordetella pertussis*, the bacterium that causes whooping cough in humans. The pertussis adjuvant is known to selectively stimulate the thymus to produce lymphocytes, which function in what is known as cell-mediated immunity.

The more familiar humoral immunity, in which antigens of the invading disease organism stimulate production of antibodies carried in the blood of the invading host, appears to be less important than cell-mediated immunity in resistance to ornithosis in turkeys. Dr. Page says resistance to chlamydial infection often exists in the absence of detectable levels of serum antibodies, and a high serum antibody level in the host is no assurance of resistance to reinfection.

In continuing studies, Dr. Page hopes to define more precisely how immunity to ornithosis is produced in turkeys and to develop a vaccine giving the desired 90 to 95 percent protection against infection.—*W.W.M.*

Bury the Pipe

A 2.0-acre cornfield, irrigated by a newly designed automatic subsurface gravity irrigation system, yielded 35 percent more silage than a field receiving twice as much water by conventional gravity irrigation system.

As labor and energy costs continue to rise and environmental considerations grow greater, the need to improve irrigation efficiency becomes important. Existing systems have efficiencies ranging from 20 to 60 percent and, in many cases, cause moderate to severe erosion, drainage, and pollution problems because of runoff and deep percolation from excessive water application.

A multiset gravity irrigation system employing closely-spaced gated surface pipe (AGR. RES., May 1975, p. 10) developed at the Snake River Conservation Research Center (Route 1, Box 186, Kimberly, ID 83341) has achieved irrigation efficiencies exceeding 80 percent. However, the multiset design has not been widely adopted because of the need to move pipes during other farming operations with considerable expenditure of labor.

ARS agricultural engineer Robert V. Worstell, Kimberly, borrowed the basic principles of the multiset system but made two important changes—he buried the pipes about 12 to 15 inches deep and he equipped the system to automatically apply light, frequent irrigations to match crop water use.

Mr. Worstell's system is controlled by a commercial irrigation con-

troller that activates low-pressure, high-efficiency valves developed by agricultural engineer Alan S. Humpherys, also at Kimberly.

Burying the pipes, which are 2 inches in diameter and made of plastic, eliminates the labor required for moving the above-ground laterals of the standard multiset system. All of the advantages of the standard multiset system, however, do remain. Like its predecessor, Mr. Worstell's system distributes water evenly throughout the field and in carefully controlled amounts.

In the test on the cornfield, the new system achieved over 90 percent water application efficiency, with very little runoff or deep percolation and no erosion. No electrical or fuel energy was required to operate the system and the only labor requirements were periodic inspections and maintenance services.

Cost and benefit estimates indicate that the multiset system with buried lateral pipes is economically feasible, practical, and should be attractive to farmers.—*L.C.Y.*

Type Tells in the Feedlot

THE RATION putting the most gain on steers in the feedlot may be adding most of the extra pounds as carcass fat. Or, depending upon type of cattle fed, it may be adding more protein than fat.

ARS animal nutritionist Ronald L. Prior and associates found that optimal feeding programs for growing and finishing small-type Angus-Hereford steers differ from those for $\frac{3}{4}$ or $\frac{7}{8}$ Charolais or Chianina crossbred steers, which are a larger, later-maturing type. The researchers compared rations designated as low, medium, and high in dietary energy, with differing roughage-to-concentrate levels.

Increasing dietary energy density generally boosted feedlot gain and feed efficiency in both groups of steers. But in small-type steers, Dr. Prior says the extra gains on the two higher-energy rations were mainly as increased fat deposition, and energy level had little effect on carcass protein. In contrast, increasing energy significantly boosted yield of retail beef cuts from large-type steers but increased fatness only slightly.

The study, at the U.S. Meat Animal Research Center (P.O. Box 166, Clay Center, NE 68933), also indicated that extra protein supplement may be profitable during about the first 2 months on feed. And during this time a higher protein level was more advantageous for large- than for small-type steers.

The growing percentage of later-maturing cattle coming into feedlots, the high cost of grain and protein supplement, and consumers' concern about the quality of retail beef all emphasize the need for defining optimum feeding programs for traditional and later-maturing types of cattle.

Dr. Prior compared nine corn-corn

silage rations supplemented with soybean meal—all combinations of three energy and three protein levels. About 2.9, 3.0, and 3.1 megacalories of metabolizable energy per kilogram were supplied in rations including about 43, 25, or 11 percent corn silage on a dry matter basis. The crude protein levels were 10, 11.5, and 13 percent.

The researchers slaughtered small steers after 196 or 232 days on feed, at respective average weights of 1,020 to 1,150 and 1,100 to 1,190 pounds. Large-type steers, requiring more time in the feedlot to reach physiological maturity, went to slaughter after 232 or 313 days, at average weights of 1,260 to 1,300 and 1,400 to 1,490 pounds.

Average daily gains of smaller Angus-Hereford steers rose as the energy level of the ration increased. In larger Charolais and Chianina cross steers, medium and high energy produced similar gains but higher than those from low energy.

Increasing energy from low to medium, but not from medium to high, increased carcass weight, marbling score, quality grade, dressed yield, fat covering, kidney and pelvic fat, and yield grade (increased fat) of Angus-Hereford crossbreds. But in the larger Charolais and Chianina crossbreds, extra energy increased carcass weight but did not significantly alter other carcass characteristics, Dr. Prior says. A significantly higher percentage of abscised livers was associated with the high-energy ration.

Fat deposition tended to be faster in small than in large steer groups on the two higher energy levels, Dr. Prior reports. The proportion of added carcass weight gained as fat, between the first and second slaughter time, was 56, 82, and 100 percent for small steers on low,

medium, and high energy, respectively.

Increase in fat for large-type steers was 56, 53, and 57 percent of total gain on the three rations between first and second slaughter. The interval between slaughter dates was 81 days for this group and only 36 days for the small-type steers.

All carcasses from both types of cattle had very acceptable palatability. Energy had little effect on flavor, juiciness, tenderness, and acceptability in taste-panel evaluation at Kansas State University, Manhattan.

Protein level in the ration did not influence slaughter weights but did affect average daily gains during the first 2 months on feed. Dr. Prior says the small steers made the best daily gains on rations furnishing 11.5 or 13 percent protein, and large steers on 13 percent protein, until they reached respective average weights of 716 and 767 pounds. From this point on, 10 percent protein was adequate for both groups.

Results indicate that cattlemen can justify the extra expense of supplement to bring the protein level up to 11.5 percent for small-type steers only until they reach about 700 pounds, Dr. Prior concludes. For large-type steers, the optimum protein level is 13 percent up to about 760 pounds. Removing all supplemental protein at 700 to 800 pounds body weight depressed subsequent gains in another experiment.

The protein level of the ration had little effect on carcass characteristics or palatability of the beef.

Nutritionist Ronald H. Kohlmeier, geneticist Larry V. Cundiff, and meat scientists Michael E. Dikeman of Kansas State and John D. Crouse of USMARC participated in the research, in cooperation with the University of Nebraska, Lincoln.—W.W.M.

AGRISEARCH NOTES

Ear tags for tick control

TICK INFESTATIONS of cattle are bad enough, but, worse, they lead to screw-worm attacks, a scourge of the Southern cattle industry. Currently, the combined effects of ticks and screwworms cause enormous losses to cattle raisers.

Now, a scientist has found that ear tags impregnated with the insecticide stirofos give 98 to 100 percent control of the Gulf Coast tick during the 7 weeks of high tick activity, thus eliminating sites where screwworm flies might deposit their eggs. No previous single (one time) treatment has been effective for the entire period of high infestation.

Gulf Coast ticks, which attach in large numbers to the inner and outer surfaces of ears of cattle, cause extreme discomfort as well as sores and swelling. For relief, the animals rub against trees and posts which often further injures their ears and heads. Cattle with badly deformed ears bring a lower price, and heavily infested animals weigh less than normal, and this also lowers their value.

More serious, however, is the fact that the lesions caused by ticks are attractive to screwworm flies. In a recent survey, researchers found that 85 percent of the screwworms infesting cattle were located at sites first injured by ticks.

Another cause for concern is that the Gulf Coast tick has established itself in east central Oklahoma and southeastern Kansas, where it is causing serious economic losses. The normal range of the tick is a strip about 100–150 miles deep along the coast of the Gulf of Mexico

and along the Atlantic Seaboard as far north as South Carolina. Its proven ability to move outside its normal range suggests that, uncontrolled, it could become a national problem.

The treatment that ARS entomologist William J. Gladney (U.S. Livestock Insects Laboratory, P.O. Box 232, Kerrville, TX 78028) devised uses insecticide-impregnated ear tags. After testing three types of tags, including doubles, with two insecticides, Dr. Gladney found that "the stirofos single large tags provided by far the most satisfactory protection and control throughout the entire 10-week test period. During the peak of Gulf Coast tick activity from July 17 to September 4, this treatment provided from 97.5 to 100 percent control."

The second most effective treatment was a small-double (on both sides of the ear) ear tag impregnated with dichlorvos. Other combinations were less effective. A treatment involving insecticide-impregnated bands attached around the horns of cattle was abandoned after 2 weeks because the bands were either attached too tightly and caused injury, or too loosely and were lost.

The stirofos treatment also provided complete protection against screwworms throughout the entire period of the study. Cattle on other treatments that were ineffective against ticks, and cattle in an untreated control group, had a high incidence of screwworm attack.

The Environmental Protection Agency has not yet approved the stirofos ear tag treatment for use.—*B.D.C.*

Tillage may control CBR

TILLAGE PRACTICES may exert an important influence on the severity of *Cyindrocladium* black rot of peanuts.

Although research results are preliminary, they indicate that the severity of black rot measured by plant infection, yield, price, and value of peanuts can be reduced by deep plowing the soil in the fall, planting the seed on a firm bed about 3 inches high and without cultivation.

Plant pathologist Morris Porter and agricultural engineer F. Scott Wright, working at the Tidewater Research Center (P.O. Box 7098, Suffolk, VA 23437), studied several combinations of tillage practices. These included: shallow and deep plowing in both spring and fall; chiseling in the spring; flat, 3-inch-high, and 6-inch-high beds; and cultivation two and four times or no cultivation.

Significantly fewer plants were infected with black rot at harvest, and yield and value were significantly greater (1,972 pounds per acre) in the deep-plowed fall treatment than in the other plowing treatments.

Similarly, shortly before harvest, significantly fewer plants were infected with black rot in the plots that were not cultivated during the entire growing season.

The researchers are quick to emphasize that these are results of only one season's study. They also emphasize that more complete control of CBR may require an integrated control program using these tillage practices along with resistant cultivars and fungicides.—*V.R.B.*



AGRISEARCH NOTES

Pattycakes for bees

BEES can be treated with antibiotics for disease control, using antibiotic extender patties, and still produce antibiotic-free honey.

These ARS findings should clear the new disease treatment method for commercial use. Antibiotic use is necessary to protect bees from colony-killing diseases. The antibiotic extender patties were made from sugar and non-medicated petroleum jelly or vegetable fat, to which 2 level teaspoons of the antibiotic, Terramycin, was added. Extender patties greatly cut labor and transportation costs in administering antibiotics to bee colonies (AGR. RES., Feb. 1971, p. 14).

Invertebrate pathologist William T. Wilson, entomologist James J. Lockett, and technician James R. Elliot at the ARS Bee Laboratory (University of Wyoming, Laramie, WY 82071) developed the patties and proved their effectiveness. However, questions arose as to whether or not this new method would result in antibiotic contamination of honey.

Seeking answers to these questions, Dr. Wilson treated nine colonies of Italian-stock honey bees, *Apis mellifera* L., in the spring with antibiotic extender patties or with conventional antibiotic dusting treatments. Three colonies were treated with patties in both spring and summer.

Honey taken from the "supers"—the boxes above the brood nests—and ex-

tracted and marketed commercially, remained contamination-free regardless of application method, duration of antibiotic treatment, or season applied. Some residue did occur in the brood nest honey (less than 4 parts per million), but this honey is used by the bees for themselves and is not generally processed for consumers.

Honey treated by the patties will meet the Food and Drug Administration's zero tolerance standards. FDA does permit some ingredients to be mixed commercially with honey, such as butter or cinnamon. With extender patties, contamination was so low in the brood nest honey that, after processing, heating, and storage of honey, antibiotics remaining in the brood nest honey would probably still fall below FDA limits or below the limits of analytical detection.—L.C.Y.

Twin-seeded hybrids yield less

TWIN-SEEDED sorghum hybrids, with two instead of the usual one seed per spikelet making up the head, offer little promise for increasing yield.

The twin-seeded hybrids had more grains per head than their single-seeded counterparts that were otherwise genetically identical. But this advantage was overcome, explains ARS agronomist Alfred J. Casady (202B Waters Hall, Kansas State University, Manhattan, KS 66506) because twin-seeded grains were smaller and weighed less, and heads were smaller because they had

fewer grain-bearing spikelets.

The average yield of single-seeded hybrids at two locations was 95 bushels an acre, significantly more than the 86 bushels an acre for the twin-seeded hybrids. Researchers found no difference between the two types in heads per plant, test weight, maturity time, or plant height.

Dr. Casady and geneticist William M. Ross compared six pairs of sorghum hybrids at Manhattan and Mead, Nebr., in cooperation with the Kansas and Nebraska Agricultural Experiment Stations. They found no difference in two-location average yields for two of the hybrids, RS610 and RS702. At Manhattan, where single-seeded RS702 produced 120 bushels an acre, its counterpart yielded 114 bushels per acre.—W.W.M.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

